THE RELATIVE EFFECTS OF VIDEO AND AUDIO MODELS ON THE ACQUISITION OF A TEACHING SKILL BY PRESERVICE ELEMENTARY TEACHERS AND CONCOMITANT STUDENT LEARNING

By

A. JOSEPH SANTIESTEBAN

A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL OF
THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1974

As a child I loved them and thought I could not love them more. How wrong I was.

I dedicate this work to Rene and Digna, my parents, for their love and guidance.

ACKNOWLEDGMENTS

I would like to thank Dr. John J. Koran, Jr., for his guidance through the conceptualization and implementation of this study and for introducing me to the realm of educational research. Dr. Mary Budd Rowe deserves my sincere thanks for her generous contributions, both to this study and to my general education. I would like to thank the members of my supervisory committee, Drs. Eugene Todd, Vynce Hines, and Robert Jester, for their constructive suggestions, and Mr. Joseph Gufford, who assisted me in securing the sample of preservice teachers. Mr. Kenneth D. Loose, my friend and colleague, has my lasting appreciation for his assistance in the analysis of this study. Finally, I thank and love Camile for her patience and understanding through this ordeal.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

Abstract of Dissertation Presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

THE RELATIVE EFFECTS OF VIDEO AND AUDIO MODELS ON THE ACQUISITION OF A TEACHING SKILL BY PRESERVICE ELEMENTARY TEACHERS AND CONCOMITANT STUDENT LEARNING

By

A. Joseph Santiesteban

August, 1974

Chairman: John J. Koran, Jr.
Major Department: Curriculum and Instruction

Forty-eight preservice elementary teachers were randomly assigned to a video model, an audio model, or a control treatment condition. Subjects in the video model treatment observed a videotape of a teacher using observation and classification questioning behavior with four fourth-grade students. Subjects in the audio model treatment listened to the audio track of the video model previously mentioned. The control Ss did not observe a model. Subsequently, all Ss prepared a 15-minute microteaching lesson. Three third- or fourth-grade students were randomly assigned to each preservice teacher, and a microteaching lesson was taught and audiorecorded.

Preservice teachers were tested with a written criterion test designed to measure identification of observation and classification questions. Elementary students were tested with a written process test designed to measure their ability to observe and classify according to item criteria.

Audiotapes of the microteaching interactions were analyzed by three trained raters for the frequency of observation questions, the frequency of classification questions by categories, the total number of classification questions, and student responses to each of the categories listed. Classification questions were coded as being either teacher-imposed classification or student-imposed classification questions. In the former category the teacher selects the characteristic to be used in classifying the objects; in the latter category the teacher allows the student to devise a classification scheme.

Subjects in the audio model treatment performed significantly better than the control Ss on the teacher criterion test. No differences were found between Ss in the audio model and the video model, or between Ss in the video model and the control group, on the teacher criterion test. No significant differences were found for main effects on the student process test. Both audio and video model Ss performed significantly better than control Ss on the frequency of observation questions, the frequency of teacher-imposed classification questions, and the total number of classification questions. No significant differences were found between audio and video model Ss on any of the audiotape interaction categories. Elementary students exposed to Ss in both audio and video model treatments responded significantly more than the controls on the observation

questions, teacher-imposed classification questions, and total classification questions categories.

This study suggests that audio models may be useful teacher-training devices when the competency to be acquired is verbal. Students exposed to teachers who have acquired the questioning skill perform better than those exposed to teachers who have not.

Chapter I

INTRODUCTION

There is a recent movement in education towards teacher-training programs based upon teacher competencies and teacher performance (Houston, 1972; Elam, 1971). Teacher-training programs of this nature usually include extensive lists of competencies teachers should acquire through training. The Florida Catalog of Teacher Competencies (Dodl, 1973) is an example of such a list. It has been suggested that appropriate teacher competencies can be identified and instructional strategies devised that maximize teacher gains and the degree of achievement of the competencies evaluated (Houston, 1972). Koran (1972) has agreed, but he added that instructional strategies for training teachers should be explored that are inexpensive, have demonstrated effectiveness, and are easily portable.

The elaboration of teaching strategies and teacher competencies gains utility if it can be shown to relate to student gains. A number of researchers on teacher behavior have indicated that little is known concerning the relationship between teacher competencies, student achievement, and student attitude outcomes (Siegel and Rosenshine, 1973; Rosenshine and Furst, 1971). Much of the research performed

on teacher behavior has been generally inconclusive with respect to student gains (Siegel and Rosenshine, 1973). Therefore, student learning and its relationship to acquired teacher competencies appears to be an area of continuing research interest.

Some researchers have shown that particular teaching skills implemented by the teacher can influence student learning. Rowe (1973, 1974) summarized some factors relating the influence of teacher wait-time on student behavior. When teachers were trained to wait at least three seconds after asking a question and to wait three seconds after a student response, a number of advantageous student behaviors developed. Some of the student characteristics associated with wait-time are: slower students contribute more to class discussion, confidence increases, speculative thinking increases, and the number of experiments proposed by students increases. Koran et al. (1973) found that students exposed to teachers trained in asking analytic questions made more analytic responses in more categories of analysis than students exposed to nontrained teachers. In this study the level of teacher acquisition of the skill was directly related to the level of subsequent student performance.

Rosenshine and Furst (1971) have suggested that research on a particular curriculum approach should consist of five phases. These five phases are as follows.

Essential components or instructional variables considered specific to a curriculum should be identified. Teachers should then be trained to use these instructional variables properly. The relationship between instructional activities and behavioral changes of the student should be identified. Modification of training procedures and/or materials should be made on the basis of the latter phase. Finally, new research with appropriate controls on training procedures and/or materials should be undertaken. This study attempts to examine the first three phases described by Rosenshine and Furst.

The Problem

The purposes of this study are: (1) to compare the relative effects of videotape and audio models on the acquisition of observation and classification questioning skills by preservice elementary teachers and (2) to validate the acquired teaching skills in terms of elementary school student learning as measured by the frequency of responses to observation and classification questions and performance on the student process test.

Modeling or Observational Learning: The Independent Variable

Modeling or observational learning are synonyms referring to the tendency of persons to imitate higher status persons, peer group members, or other relevant models

(Bandura and Walters, 1963). As Bronfenbrenner (1970) has stated, the behavior of others is contagious. Modeling has been variously termed imitation, observational learning, identification, psychological modeling, role-taking, copying, and introjection (Bandura, 1971).

Models can be presented in a number of different ways, the most common form being the live model. Children and adults observe the behaviors of others and adopt many of these behaviors. Bandura et al. (1963) found that live models are as effective as film-mediated models in producing behavior change. From this study alone, however, it cannot be concluded that film models and live models are equivalent in effect. It is most probable that the effect of alternate modeling methods depends on the number of exposures to each model, the relative strength of the models, the task modeled and the characteristics of the observer. With the advent of television and films, film-mediated models have become popular devices for influencing behavior and under many conditions are very effective in influencing behavior (Bandura, 1971). Modeling can also be conveyed through symbolic means in the form of written communications. Written models have been found to be effective devices in behavioral change for teacher trainees (Koran et al., 1973).

Bandura and Walters (1963) have outlined three main effects derived from the observation of a model. 1) The

observer may acquire new responses that did not previously exist in his repertoire. 2) Through observation of a model an individual performs a behavior that he had not previously produced. 3) The observation of a model may strengthen or weaken existing responses, or the model may increase or decrease the frequency of behaviors already possessed by the observer. Observation of a model that is either rewarded or punished may increase or decrease the performance of the observed behavior. Behaviors displayed by the model may be acquired without the observer overtly reproducing the behavior. The newly acquired behaviors may be stored and later used if an appropriate set of circumstances develop. This is related to the acquisition-performance phenomenon described by Bronfenbrenner (1970) and suggested by research (Bandura et al., 1963; Bandura, 1971; Koran, 1969a, 1970, 1971a). An individual may observe a model using a rifle and acquire the necessary behaviors for using the weapon. But, if the individual does not actually manipulate the weapon, he will be unable to perform the acquired behaviors (Bronfenbrenner, 1970).

Psychological Theory and Modeling

Bandura (1970) has suggested that a number of major processes are involved in observational learning. Analysis of the social aspect of observational learning places much importance on the role of representational mediators that

are assumed to be acquired as a function of the contiguity learning process (Bandura, 1969). According to this contiguity-mediational theory, while the subject observes the modeling stimuli, configurations and sequences of sensory experiences are elicited. Then, on the basis of past associations the stimuli become integrated into perceptual responses (Bandura et al., 1966). Stimulus contiguity must be accompanied by the mediational performance of discriminations between observations. This is necessary to facilitate the learning process (Bandura, 1970).

During exposure to stimulus sequences (observation of a model) the observer tends to code, classify, and reorganize elements into more easily remembered schemes. Elements (stimuli) are performed either overtly or covertly. Where overt performance is not feasible, covert performance acts as a practice variable.

Sheffield (1961) has described symbolic or representational responses in the form of images and verbal associates as perceptual blue-printing. Patterns become the essential elements and, when acquired, the patterns allow the observer to reproduce overt sequences of the patterns. These overt sequences do not have to be precisely like the observed patterns. Overt sequences may be reproduced at the time of observation, or stored and reproduced at a later time. The advantage of such a sequence is that it provides a distinctive stimulus context within which appropriate response items can be cued.

Modeling and Teacher Training

With the ever-increasing cost of education it is necessary that techniques in teacher training be developed that are effective, inexpensive, and portable (Koran, 1969a, 1972). Modeling approaches show promise as techniques which may prove useful in training teachers inexpensively and effectively. Videotape modeling has been found effective in promoting questioning behavior change in preservice teachers. Koran (1969b) found that a film-mediated (videotape) model was more effective than a written model in training preservice teachers in producing observation and classification questions.

A videotape model was compared to a self-rating procedure in another study by Koran (1970). In that study, preservice teachers observed a kit of Science-A Process Approach materials. Each teacher was then asked to generate, in writing, observation and classification questions they would ask about the material. Part of the group observed a teacher-pupil interaction of a teacher eliciting observation and classification responses while the other group self-rated their questions generated on a pretest using a rater-protocol as a guide. After two weeks, the Ss responded to a retention test. Written questions generated by the Ss were rated as to whether they were observation and classification questions. Koran found that the

videotape model was superior to the self-rating system in producing results on the retention test, but not on initial acquisition of the skills.

In a follow-up study, Koran (1971a) compared the effects of written and film-mediated models on the acquisition of observation and classification eliciting skills by preservice elementary teachers. Again Koran found that videotape models were superior to written models. The written model produced significantly more desired behaviors than the control even though the Ss in the written model treatment group scored significantly lower than the video model group or the control group on the pretest. M. L. Koran et al. (1971) found that a videotape model was more effective than a written model, but both modeling groups scored significantly higher than the no-modeling group in the quantity and quality of analytic questioning behavior.

Koran et al. (1973) compared two types of written models to determine their relative effect on analytic questioning behavior of preservice teachers. One model, "the protocol model," was administered to a group of randomly assigned preservice teachers. The model consisted of a set of explicit definitions and sample questions related to analytic questioning. Another group received a transcript of a teacher-pupil interaction. The analytic questioning behaviors were highlighted within the communication. A third nontreatment group served as the control. Each

teacher prepared a 20-minute microteaching session using a selected article as a basis for instruction after which the teacher microtaught the lesson to three or four eighth graders. Each microteaching session was audiorecorded and the students and teachers were administered written tests at the conclusion of the session. Ratings of the audiotapes showed that the protocol model was more effective than the written model in producing both types and frequency of analytic questions. Protocol model Ss did not perform as well as the written model Ss on the written measures but did perform significantly better than the control group. Children in both modeling treatments performed significantly better than the control on the ability to distinguish between types of analytic questions. The difference between modeling treatments and the control was not significant on content and transfer tests administered to the children. One of the most interesting effects found was that students exposed to teachers who asked more analytic questions responded with more analytic responses, and their responses were more varied.

The evidence so far presented suggests that the film-mediated model is superior to the written model in producing desired questioning behavior of the types described. Both models are superior to no-model conditions. Modeling conveyed through audiorecordings has not been experimentally

investigated as a mode of training teachers on the evolving lists of teacher competencies.

Since many desired teacher behaviors are verbal, audio modeling techniques may be suitable alternatives to audio-visual presentations for teaching these behaviors. If audio modeling is effective as a training method, it offers a number of advantages over video models.

Modeling in Children

Three sets of conditions affecting the modeling process in children are: (1) the characteristics of the subject, (2) the characteristics of the stimulus act, and (3) the characteristics of the model (Bronfenbrenner, 1970; Bandura, 1971).

Characteristics of the Subject. In the first condition, the subject must be able to perceive the stimulus act and perform the same act or other associated behaviors (Bandura, 1971). Differential age responses to certain models have been reported (Denney, 1972; Leifer et al., 1971; Liebert et al., 1969). In a number of studies older children have modeled the behaviors in significantly higher frequencies than younger children. Masters and Morris (1971) report that boys tend to imitate a male or female model to a greater degree than girls and that boys show greater variability of response. In the Masters and Morris study a female model displayed agression while a male

counterpart performed as a neutral model. In a study by Portuges and Feshbach (1972) advantaged and disadvantaged third and fourth graders were used as subjects in a study to compare the acquisition of incidental behaviors through film-mediated models. Advantaged girls modeled the positively reinforcing white teacher significantly more than advantaged white boys. Disadvantaged girls displayed fewer incidental behaviors than advantaged boys while the disadvantaged boys displayed fewest incidental behaviors. Incidental behaviors in this study are defined as gestures or remarks not essential to the communication. Folding the arms during questioning, clasping hands, encouraging students with remarks such as "think hard" are considered incidental behaviors by the authors. The apparent contradiction between the two studies cited may be due to the use of a bearded male model in the Masters and Morris study. The authors hypothesize that the male model may have dampened imitation of the model by the girls.

Characteristics of the Stimulus Act. Complex behaviors may be more easily learned through modeling if they are divided into smaller components (Bandura et al., 1966). The relation of one act to the next in a sequence exhibited by the model becomes important when the model divides the complex behavior into small components, labeling each component in sequence.

Characteristics of the Model. The third set of conditions has the greatest potential for influencing the modeling process (Bronfenbrenner, 1970). 1) The potency of the model increases with the extent to which the model is perceived as possessing a high degree of competence, status, and control over resources (Bandura et al., 1963). Teachers that perform more effectively as evidenced by the appropriate implementation of the desired competencies may produce more modeling of the desired outcomes in the students. 2) The inductive power of the model increases with the degree of prior nurturance or reward exhibited by the model (Bandura and Huston, 1961; Mussen and Parker, 1965). The most powerful models in a child's life are those perceived by the child as major sources of support and control. 3) The most effective models for the child are likely to be those who are the major sources of support and control in his environment. Parents, peers, older children, and adults who are important act as supportive agents and as models (Bandura and Walters, 1959; Hartup, 1969). Teachers are often sources of support and certainly control a part of the child's environment. Teachers who are more capable as measured by their performance during classroom instruction may appear to have greater control of the environment and thus be modeled to a greater extent. 4) The inductive power of the model increases with the degree to which the person perceives the model as similar to himself (Rosekrans,

1967; Burnstein et al., 1961; Stotland et al., 1962; Stotland and Dunn, 1962). Children imitate models similar to themselves. Female teachers may produce greater modeling behavior in female students; corresponding results may be noted for male teachers and male students. The evidence here is inconclusive; much research needs to be performed with respect to sex and race as modeling variables. 5) Several models exhibiting similar behaviors are more powerful inducers of change than a single model (Bandura, 1967). The students in this study had only one exposure to the microteacher as a model. 6) The potency of the model is enhanced when the behavior exhibited is a salient feature in the actions of a group of which the child already is or aspires to be a member (Bronfenbrenner, 1970). Measures of student aspirations were not employed in this study. 7) The power of the model to induce actual performance (as distinguished from acquisition) is strongly influenced by the observed consequences for the model of the exhibited behavior (Bandura, 1965a, 1965b; Bandura, 1971; Bandura et al., 1963). That is, a child may acquire a behavior but may not perform the behavior until a particular set of circumstances is present. The relevance of the foregoing discussion is that, if training effects are observed on teacher behavior, one explanation for concomitant student behavior changes would be that students modeled the behaviors demonstrated by the teacher.

Modeling and Reinforcement

Modeling appears to produce significant effects when presented without positive reinforcement to the observer or the model (Bandura and Walters, 1963; Bandura et al., 1966; Bandura, 1969; Masters and Morris 1971). Yet, in some studies, positive reinforcement has been essential in producing significant effects (Masters and Morris, 1971; Zimmerman and Pike, 1972; Geshuri, 1972). Liebert et al. (1969) have found that modeling plus reward yields significant results with young children as subjects. It has been hypothesized by a number of the researchers mentioned that imitation of a model is in some fashion a form of vicarious reinforcement. Here lies one of the conflicts that requires further investigation. Modeling alone produces behavioral change; modeling plus reinforcement also produces behavioral change. Which procedure is more effective in an elementary classroom setting or in a teacher-training situation? In this study the type of verbal reinforcement and the frequency of reinforcement were held constant for both models.

Observation and Classification in Concept Formation: The Dependent Variable

A number of science curricula in elementary science education focus upon the teaching of concepts (for reviews and descriptions, see Hurd and Gallagher, 1968; Karplus and

Thier, 1967). One of these, the Science Curriculum Improvement Study, or SCIS, bases its approach on the acquisition of certain essential concepts by the elementary student (Karplus and Thier, 1967). Equilibrium, interaction, and systems represent abstract concepts found in SCIS that are subsumed by less complex concepts such as communities, populations, and food web in the life science stream. There are corresponding illustrations in the physical science stream.

Another elementary science curriculum, Science-A Process Approach, or SAPA, uses selected concepts as vehicles leading to the acquisition of processes (Gagné, 1963). Once formed, concepts are used to develop both basic and higher level scientific processes. Colors, shapes, sizes are concepts employed leading to the acquisition of basic processes such as observing, classifying, and communicating. Examples of higher level processes are controlling variables, interpreting data, and experimenting.

According to Pella (1966), Koran (1971b), and Mechner (1965), concepts are formed by four essential steps: observation, classification, generalization, and discrimination. Mechner has provided an example for the four steps in concept formation in his discussion of the concept of shape. A person observes a number of different triangles, he classifies the figures as a set, he generalizes within the set, and then he is able to discriminate between sets.

In other words, an individual generalizes among things when he makes the same response to different things (calls large and small three-sided figures "triangles") and discriminates between classes of things when he makes different responses to different classes (triangles are different from circles). Gagné (1970) agreed in principle with the four steps of concept formation as presented and suggested that, once formed, concepts allow the individual to simplify his environment by reducing the cognitive load.

Independent and Dependent Variables

The independent variables in this study are the video model, the audio model, and the no-model treatment or control. The video model is a ten-minute videotape of a teacher asking observation and classification questions of four fourth graders. The audio model consists of a ten-minute audiotape of the sound track of the video model previously mentioned. A control group will neither view nor listen to the model.

The dependent variables in this study are teacher and student microteaching performances, teacher criterion test performance, student process test performance, and student attitude test performance. Frequencies of observation questions, frequencies and categories of classification questions, and total classification questions will be dependent variables for the teacher microteaching performance.

Student microteaching performance will be measured by frequencies of responses to observation questions, frequency and categories of classification questions, and total number of responses to classification questions.

Research Hypotheses

Based upon the previous discussion of the literature, the following research hypotheses were tested.

1) Teachers observing the video model will produce higher frequencies of observation questions and higher frequencies in more categories of classification questions than teachers not exposed to the model as measured by audiotape and written performances.
2) Teachers listening to the audio model will produce higher frequencies of observation questions and higher frequencies in more categories of classification questions than teachers not exposed to the model as measured by audiotape and written performances.
3) The video model will be more effective than the audio model in producing higher frequencies of observation questions and higher frequencies in more categories of classification questions as measured by audiotape and written performances.

4) Teachers eliciting higher frequencies of observation questions and higher frequencies in more categories of classification questions will produce higher student scores on written test and audiotape performances.

CHAPTER II

EXPERIMENTAL DESIGN

The Design

A modified postest only, control group design as described in Table 1, was used for this study. Although the design does not permit evaluation of entering behavior for teachers, random assignment of the subjects assures equivalent entry behavior. The design allows for a comparison of the relative effects of the treatments. The use of observation and classification questioning skills should be sufficiently novel so that random assignment of preservice teachers to treatment groups guards against previous sporadic acquisition of the skills. In order to measure the entering behavior of students, 40 third and fourth graders were randomly assigned to a posttest only, no microteaching treatment. This group, by taking only the posttest, served as a measure of entering behavior for students. A comparison was then possible between the posttest only, no-microteaching group, and the microteaching groups to determine if the skills measured by the student process test had been achieved prior to the microteaching session. The research model is described in Table 2.

Table 1

Experimental Design

	Treatment	Measures
Teachers		
R	X_1	O_1 O_4
R	X_2	O_1 O_4
R	--	O_1 O_4
Students		
R		O_1 O_2 O_3
R		O_1 O_2 O_3
R		O_1 O_2 O_3
		-- O_2 O_3

X_1 = video model, X_2 = audio model, O_1 = audio-recording of microteaching session, O_4 = teacher written criterion measure, O_2 = student process test, and O_3 = student attitude measure.

Table 2

Research Model

	Acquisition Measures			
Treatments	Audio-Recording	Teacher Criterion Test	Student Process Test	Student Affective Measure
Video model	✓	✓	✓	✓
Audio model	✓	✓	✓	✓
Control	✓	✓	✓	✓
Student post-test cell	--	--		--

Treatment Procedures

Subjects

Forty-eight preservice teachers, enrolled in two sections of a general curriculum course, were selected as subjects for this study. All preservice teachers were college seniors working on kindergarten-through-twelfth grade teacher certification in music, physical education, or library science. Most of the subjects were between the ages of 20 and 24, with three of the sample being above the age of 30. None of the preservice teachers had participated in student teaching.

One-hundred-eighty-four third and fourth graders enrolled at a local elementary school were chosen as microteaching subjects. Three third-grade and four fourth-grade classes were used. A breakdown of the student population by sex, grade, and race is shown in Table 3. Neighborhoods from which much of the student population is drawn can be characterized as lower-middle class.

General Procedures

Preservice teachers in each class section were informed that a mandatory microteaching session would be part of the course requirements. Each section was given a general introduction to the microteaching session. Preservice teachers were asked to sign-up for the microteaching session

during a convenient time. Maps and general directions to the elementary school were furnished for each preservice teacher.

Table 3

Means and Standard Deviations of Student Process Test by Sex, Grade, and Race

	N	Mean	SD
Sex			
Males	81	14.20	5.48
Females	103	16.05	4.09
Grade			
Third	85	14.29	5.08
Fourth	99	16.04	4.47
Race			
White	135	16.73	3.38
Black	49	11.12	5.78

N = 184.

Preservice teachers were randomly assigned to one of the three treatment groups. A set induction, generally describing concept formation, and instructions on the task to be performed were administered to each preservice teacher upon arrival at the school. Subjects assigned to modeling treatments received a set of directions slightly different

from directions given to subjects assigned to the control group. Examples of the set inductions are found in Appendix A. The only difference between set inductions was that the instructions for the modeling subjects made reference to a demonstration the subjects were to observe. All preservice teachers viewed the Science-A Process Approach materials before continuing with the treatments. After observing the model, modeling treatment subjects prepared a microteaching lesson using Science-A Process Approach materials. A list of materials used in the study is found in Appendix B. Control subjects did not observe the model but immediately began preparing the microteaching lesson using the same materials.

Since classroom space was at a premium, it was necessary to convert a science equipment storage room into the microteaching lab. The room was large, clean, well-lighted and equipped with a table and four chairs. All treatments and testing situations were performed in this room. Microteaching students were escorted from their classroom to the microteaching lab by the investigator or one of his assistants.

Once students were seated, the preservice teacher was reminded to teach at least 15 minutes, the cassette recorder was started, and the experimenter left the room. After 15 minutes the experimenter shut off the cassette recorder, requested that the materials be put into a box, and

administered written tests to the preservice teacher and microteaching students. Students were read the test directions. Words were pronounced if a request for help by the microstudents was made. Twenty minutes was available to complete the tests but neither preservice teachers nor microteaching students required the allotted time. Treatment procedures and times for each procedure are listed in Table 4.

Table 4

Treatment Procedures and Times

Steps	Time[a]
Set Induction	5 min.
a) Introduce concept	
b) Introduce procedures	
c) Introduce materials	
Treatments	
a) Video	10 min.
b) Audio	10 min.
c) Control	--
Lesson preparation	5 min.
Microteaching session	15 min.
Teacher, student tests	20 min.

[a]Total time: teachers, 55 min.; students, 35 min.

Treatment Materials

The Models

The video model consisted of a 10-minute segment of a videotape exhibiting a female teacher using observation and classification questions with four fourth graders in a microteaching lab. Science-A Process Approach observation and classification materials were used by the model teacher and students. The teacher in the video model asked a high frequency of observation and classification questions. Fourth graders could be seen manipulating the materials and their responses were clearly audible. The audio model was a taperecording of the same teacher-pupil interaction.

The Materials

Science-A Process Approach observation and classification materials were provided for each teacher in a kit form. The materials permitted a wide range of observation and classifications by color, shape, texture, and size. The materials consisted of variously colored wood blocks, balloons, construction paper rectangles and squares, pieces of felt, and nuts. The video model was shown through the use of a 19-inch monitor and a Sony 2200V Videocorder. Wollensak audio cassette recorders were used to exhibit the audio model and record the microteaching interaction.

Written Measures

At the conclusion of the microteaching session, preservice teachers received a 29-item criterion test. The criterion test required the selection of those statements or questions that were observations, classifications, or neither. Students received a 20-item process test designed to measure their acquisition of observation and classification processes. Geometric figures, such as triangles, rectangles and circles, along with a few terms, were categorized according to individual item criteria. Upon completion of the process test, students received an 11-item attitude test. Attitudes toward the microteaching lesson, the tasks performed, and feelings for the teacher were explored. The attitude measure used a modified Likert scale. The affective responses to each item were coded on a 3-point scale, from agreement with the statement to disagreement. Copies of the teacher criterion test, student process test, and student attitude test are found in Appendix C.

Reliability of Written Measures

Both the teacher criterion test items and the student process test items were subjected to a point bi-serial correlational technique to evaluate item reliability. This method of determining reliability estimates the discriminatory power of each item between subjects that score low on

the test and those that score high. Item difficulty, defined as the percent answering the item incorrectly, was also calculated. High values indicate the item was difficult. The point bi-serial correlations and item difficulties are shown in Tables 5 and 6. The mean difficulty for

Table 5

Item Analysis--Teacher Criterion Test

Question	Difficulty[a]	Point Bi-serial
1	0.27	0.40
2	0.23	0.46
3	0.63	0.43
4	0.69	0.34
5	0.63	0.18
6	0.29	0.24
7	0.60	0.30
8	0.60	0.34
9	0.69	0.39
10	0.79	0.17
11	0.31	0.29
12	0.73	0.44
13	0.58	0.34
14	0.48	0.63
15	0.48	0.36
16	0.13	0.18
17	0.02	0.44
18	0.90	0.15
19	0.65	0.12
20	0.69	0.21
21	0.63	0.32
22	0.50	0.27
23	0.54	0.08
24	0.75	0.46
25	0.52	0.36
26	0.21	0.41
27	0.60	0.49
28	0.67	0.13

[a]The mean difficulty for this test was 0.53.

the teacher criterion test was 0.53 while the mean difficulty for the student process test was 0.24. The Cronbach alpha technique for determining test reliability was computed for each test. Test reliabilities are reported in Table 7.

Table 6

Item Analysis--Student Process Test

Question	Difficulty[a]	Point Bi-serial
1	0.09	0.22
2	0.34	0.48
3	0.41	0.42
4	0.42	0.69
5	0.29	0.55
6	0.32	0.37
7	0.29	0.60
8	0.30	0.59
9	0.32	0.63
10	0.30	0.59
11	0.16	0.73
12	0.16	0.78
13	0.21	0.72
14	0.32	0.64
15	0.18	0.58
16	0.18	0.65
17	0.11	0.58
18	0.24	0.59
19	0.13	0.63
20	0.20	0.67

[a]The mean difficulty for this test was 0.24

Table 7

Reliability of Written Measures

Measure	N	No. of Items	Reliability
Teacher criterion test	48	28	.67
Student process test	184	20	.86

Audiotape Analysis

Rater Training Procedures

Three college freshmen were hired to perform the analysis of the tapes. Raters were trained for approximately 20 hours to code observation questions, teacher-imposed classifications, student-imposed classifications, and appropriate student responses to the categories noted. The raters and experimenter observed a random selection of tapes. Appropriate responses were verbally highlighted. Following this procedure, another group of tapes was selected and rated. Feedback on correct and incorrect questions and responses was immediate. Once the experimenter believed the raters had reached a high level of proficiency, an analysis of rater reliability was performed on three tapes chosen at random. Further training was necessary since the raters had difficulty in determining the categories in which classification questions belonged. A second analysis of rater reliability was conducted using 10 randomly selected tapes. Since this second analysis was satisfactory, raters were allowed to rate the remaining tapes. Table 8 lists the rater reliability for each variable. Appendix D includes a copy of the rater manual.

Catefories for Tape Analysis

Audiotapes were analyzed for frequencies and categories of observation questions by preservice teachers, frequencies

Table 8

Rater Reliability for Verbal Measures

Measures	Mean Rater Reliability
Observations	
Observation questions	
Student observation responses	.92
Classifications	.92
Teacher-imposed categories	.83
Student responses	.83
Student-imposed categories	.92
Student responses	.91
Total classification questions	.93
Total student responses	.92

and categories of classification questions, and frequency and categories of student responses. Observation questions required the student to identify a particular characteristic of an object such as its shape, color, or texture. Questions such as: What color is this? and How does this feel? are examples of observation questions. Classification questions required students to compare, contrast, or group objects by similarities and dissimilarities. Teacher-imposed categories required the student to classify objects by characteristics the teacher selects. Which colors belong together? and Which are the rough ones? are examples

of teacher-imposed categories. In each of the latter questions the teacher told the students which characteristics are to be considered in classifying the objects presented. Student-imposed classification questions required the student to select an appropriate characteristic for categorizing objects. Examples of student-imposed classification questions are: How can you group these? and How are the objects different? When the teacher selected a student-imposed category for classification, he allowed the student to devise a scheme for classification. Correct student responses to observation and classification questions were tabulated under the appropriate student response category. Examples of observation and classification questions and the rater form are found in Appendix D.

CHAPTER III

RESULTS

The major objectives of this study were: (1) to compare the relative effects of audio and video models on the acquisition of teaching skills by preservice teachers and (2) to determine if student learning would increase as the teaching skills were implemented.

Main Effects

Main effects were evaluated using two general modes of measurement. Upon completion of the microteaching session, preservice teachers and students were evaluated by use of written measures. These measures were of the objective type, and items were scored either correct or incorrect. During the microteaching session the verbal interaction between preservice teacher and students was audiorecorded. The audiorecordings were rated for specific verbal behaviors previously described. Comparisons between treatment groups and the dependent variables comprised the tests for main effects. Interaction effects were analyzed for the student process test. Neither the teacher criterion test nor the microteaching audio interactions were analyzed for interaction effects since the sample (N=48) was small.

Written Measures

The teacher criterion test had a range of scores from 1 to 22, with a mean of 13.23 and a standard deviation of 4.07. Cell sizes, cell means, and cell standard deviations are reported in Table 9. A one-way analysis of variance was used to determine if significant differences occurred between groups. A significant difference was found ($F=3.77$, $p<.05$). A test for significant differences between means using Tukey's HSD test was performed whenever significance was encountered. A harmonic cell size mean of 15.97 was calculated and used in computing the HSD. On the teacher criterion test the audio model Ss performed significantly better than the control Ss. No significant differences were found between the video and audio models and the video model and the control groups.

Table 9

Means and Standard Deviations for Written Measures

Measure	N	Mean	SD
Teacher criterion test			
Total group	48	13.23	4.07
Video model	16	13.31	3.38
Audio model	17	14.94	3.81
Control	15	11.20	4.33
Student process test			
Total group	184	15.23	4.83
Video model	48	14.94	5.07
Audio model	51	15.57	4.49
Control	45	15.38	4.77
No treatment	40	15.00	5.15

Scores on the student process test ranged from 1 to 20, with a mean of 15.23 and a standard deviation of 4.83. A one-way analysis of variance technique found no significant differences for the student process test between groups. The results of the analysis of variance are reported in Table 12. Cell sizes, cell means, and cell standard deviations for the student process test are listed in Table 9. Two-way analyses of variance were performed by sex and treatment, grade and treatment, and race and treatment for the student process test. This analytic technique was employed to determine if interactions existed between treatments and sex, grade, and race. No significant differences were found for interactions or treatments by sex, grade, and race. Significant differences were found between males and females, third and fourth graders, and between black and white students, with female students scoring significantly better than males ($F=7.74$, $p<.01$) on the process test, fourth graders scoring significantly higher than third grade-students ($F=6.25$, $p<.05$), and white students performing significantly better on the student process test ($F=72.87$, $p<.01$) than black students. Summaries of the two-way analyses of variance are listed in Tables 13, 14, and 15. Cell sizes, means, and standard deviations for the two-way analyses of variance are reported in Table 3.

Table 10

Analysis of Variance for Teacher Criterion Test

Source of Variation	SS	df	MS	F
Between groups	111.70	2	55.85	3.77*
Within groups	666.77	45	14.82	
Total	778.48	47		

N = 48.
*$p < .05$.

Table 11

Tukey's HSD Test for Difference Between Means--
Teacher Criterion Test

Treatment	Cell Mean	Cell N
1) Video	13.31	16
2) Audio	14.94	17
3) Control	11.20	15

Contrasted Pairs	1-2	1-3	2-3
Difference between means	-1.73	2.21	3.74*

Tukey's HSD: *($p \leq .05$) = 3.30;
**($p \leq .01$) = 4.19.

Cell size mean = 15.97.

Table 12

Analysis of Variance for Student Process Test

Source of Variation	SS	df	MS	F
Between groups	13.05	3	4.35	0.18
Within groups	4253.89	180	23.63	
Total	4266.94	183		

N = 184.

Table 13

Analysis of Variance for Student Process Test
by Sex and Treatment

Source of Variation	SS	df	MS	F
Sex	174.71	1	174.71	7.74**
Treatment	16.17	3	5.39	0.24
Interaction	118.57	3	39.52	1.75
Within	3972.51	176	22.57	

N = 184.
**$p < .01$.

Table 14

Analysis of Variance for Student Process Test
by Grade and Treatment

Source of Variation	SS	df	MS	F
Grade	140.99	1	140.99	6.25*
Treatment	4.99	3	1.66	0.07
Interaction	154.33	3	51.44	2.28
Within	3973.23	176	22.58	

N = 184.
*$p < .05$.

Table 15

Analysis of Variance for Student Process Test
by Race and Treatment

Source of Variation	SS	df	MS	F
Race	1238.42	1	1238.42	72.87**
Treatment	120.53	3	40.18	2.36
Interaction	128.61	3	42.87	2.52
Within	2991.18	176	16.99	

N = 184.
** $p < .01$.

Microteaching Audio Interaction

Eight dependent variables were examined by the raters from the audiotape recordings. The dependent variables for preservice teachers which were derived from audio recordings were: total number of teacher observation questions, number of teacher-imposed classification questions, number of student-imposed classification questions, and the total number of classification questions asked by the preservice teachers. Classification questions were rated as using either teacher-imposed or student-imposed categories for classification. A discussion of the essential elements of each type of classification question is found in Chapter II. Appendix D contains examples of observation and classification questions. Four audio interaction dependent variables for students were examined. They were: the number of student responses to teacher observation questions, student

responses to teacher-imposed classification questions, responses to student-imposed classification questions, and the total number of student responses to classification questions.

One-way analyses of variance were used to test the audio interaction dependent variables for significant differences. Both audio and video model groups scored significantly better than the control group ($F=6.87$, $p<.01$) on the total number of observation questions asked. No significant difference was found between the audio and video model treatments of the frequency of observation questions asked. Analysis of the teacher-imposed category dependent variable indicated that both audio and video models were significantly better than the control group ($F=8.64$, $p<.01$). No significant difference was found between audio and video model treatments. Analysis of the student-imposed category dependent variable indicated that no significant differences existed ($F=2.76$). Although both video and audio model groups had higher cell means than the control (4.00, 5.71, and 2.07 respectively), the differences were not sufficient to produce significance at $p<.05$. Video and audio model groups produced greater frequencies of total classification questions than the control ($F=9.16$, $p<.01$). No significant difference was found between the audio and video model groups for total number of classification questions asked by the preservice teachers. Tables 16 through 19

summarize the results of the one-way analyses of variance on the teacher microteaching performance. Tukey's HSD tests are reported in Tables 20 through 22.

Table 16

Analysis of Variance for Teacher Observation Questions

Source of Variation	SS	df	MS	F
Between groups	249.37	2	124.69	6.87**
Within groups	816.54	45	18.15	
Total	1065.92	47		

$N = 48$.
**$p < .01$.

Table 17

Analysis of Variance for Teacher-Imposed Classification Questions

Source of Variation	SS	df	MS	F
Between groups	275.73	2	137.87	8.64**
Within groups	717.94	45	15.95	
Total	993.67	47		

$N = 48$.
**$p < .01$.

Table 18

Analysis of Variance for Student-Imposed Classification Questions

Source of Variation	SS	df	MS	F
Between groups	105.54	2	52.77	2.76
Within groups	860.46	45	19.12	
Total	965.99	47		

N = 48.

Table 19

Analysis of Variance for Total Classification Questions

Source of Variation	SS	df	MS	F
Between groups	671.81	2	335.90	9.16**
Within groups	1650.17	45	36.67	
Total	2321.98	47		

N = 48.
**$p < .01$.

Table 20

Tukey's HSD Test for Difference between Means--Teacher Observation Questions

Treatment	Cell Mean	Cell N
1) Video	8.12	16
2) Audio	6.24	17
3) Control	2.53	15

Table 20--(continued)

Contrasted pairs	1-2	1-3	2-3
Difference between means	1.88	5.59**	3.71*

Tukey's HSD: *($p \leq .05$) = 3.66;
**($p \leq .01$) = 4.64.

Cell size mean = 15.97.

Table 21

Tukey's HSD Test for Difference Between Means--
Teacher-Imposed Classification Questions

Treatment	Cell Mean	Cell N
1) Video	7.19	16
2) Audio	6.88	17
3) Control	1.87	15

Contrasted pairs	1-2	1-3	2-3
Difference between means	.31	5.32**	5.01**

Tukey's HSD: *($p \leq .05$) = 3.43;
**($p \leq .01$) = 4.35.

Cell size mean = 15.97.

Table 22

Tukey's HSD Test for Difference Between Means--
Total Classification Questions

Treatment	Cell Mean		Cell N
1) Video	11.56		16
2) Audio	12.47		17
3) Control	4.00		15
Contrasted pairs	1-2	1-3	2-3
Difference between means	.91	7.56**	8.47**

Tukey's HSD: *($p \leq .05$) = 5.20;
**($p \leq .01$) = 6.60.

Cell size mean = 15.97.

Analysis of the frequency of student responses to teacher observation questions was found to be significant ($F=6.28$, $p<.01$). Both audio and video model groups were significantly better than the control group but not significantly different from one another. Audio and video model treatments were superior to the control group in producing student responses to teacher-imposed classification questions ($F=8.23$, $p<.01$). Again, no difference was found between audio and video model treatments on the frequency of student responses to teacher-imposed classification questions.

No significant differences were found for student responses to student-imposed classification questions ($F=2.47$). The difference between groups for the total frequency of student responses to teacher classification questions was found to be significant ($F=8.96$, $p<.01$). Both video and audio model groups were superior to the control group, yet no significant difference was found between the audio and video model treatments on the frequencies of student responses. Tables 23 through 26 summarize the one-way analyses of variance on student performances on the microteaching audio interaction dependent variables. Tukey's HSD test for significant differences are found in Tables 27 through 29.

Results of the correlations between audiotape dependent variables indicate that the frequencies of teacher questions and student responses within the same category correlate very highly (Table 30). There are also high correlations between total classification questions, teacher-imposed classification questions, and student-imposed classification questions. This finding is consistent with previously reported data, since teacher-imposed classification and student-imposed classification questions were summed to produce the total classification question category. It also suggests that, when teachers are trained to elicit more of these types of responses from students, the concomitant response category is high, and one can propose that the probabiltiy of greater learning is these categories is increased.

Table 23

Analysis of Variance for Student Responses to Observation Questions

Source of Variation	SS	df	MS	F
Between groups	225.03	2	112.51	6.28**
Within groups	806.64	45	17.93	
Total	1031.67	47		

N = 48.
** $p < .01$.

Table 24

Analysis of Variance for Student Responses to Teacher-Imposed Classification Questions

Source of Variation	SS	df	MS	F
Between groups	230.80	2	115.40	8.23**
Within groups	630.86	45	14.02	
Total	861.67	47		

N = 48.
**$p < .01$.

Table 25

Analysis of Variance for Student Responses to Student-Imposed Classification Questions

Source of Variation	SS	df	MS	F
Between groups	80.83	2	40.43	2.47
Within groups	735.62	45	16.35	
Total	816.48	47		

N = 48.

Table 26

Analysis of Variance for Student Responses to Total Classification Questions

Source of Variation	SS	df	MS	F
Between groups	572.50	2	286.25	8.96**
Within groups	1438.17	45	31.96	
Total	2010.67	47		

N = 48.
**p < .01.

Table 27

Tukey's HSD Test for Difference Between Means--Student Responses to Observation Questions

Treatment	Cell Mean		Cell N
1) Video	7.81		16
2) Audio	6.17		17
3) Control	2.53		15
Contrasted pairs	1-2	1-3	2-3
Difference between means	1.63	5.28**	3.65*

Tukey's HSD: *($p \leq .06$) = 3.64.
**($p \leq .01$) = 4.61.

Cell size mean = 15.97.

Table 28

Tukey's HSD Test for Difference Between Means--Student Responses to Teacher-Imposed Classification Questions

Treatment	Cell Mean		Cell N
1) Video	6.50		16
2) Audio	6.29		17
3) Control	1.67		15
Contrasted pairs	1-2	1-3	2-3
Difference between means	.21	4.83**	4.62**

Tukey's HSD: *($p<.05$) = 3.21.
**($p<.01$) = 4.08.

Cell size mean = 15.97

Table 29

Tukey's HSD Test for Difference Between Means--Student Responses to Total Classification Questions

Treatment	Cell Mean		Cell N
1) Video	10.75		16
2) Audio	11.53		17
3) Control	3.73		15
Contrasted pairs	1-2	1-3	2-3
Difference between means	0.78	7.02	7.80**

Tukey's HSD: *($p<.05$) = 4.85.
**($p<.01$) = 6.16.

Cell size mean = 15.97.

Table 30

Correlation Matrix for Audio Interaction Dependent Variables

Teacher Observa-Vation Questions	Responses to Obser-vation Questions	Teacher-Imposed Classifi-cation Questions	Responses to Teacher-Imposed Classifi-cation Questions	Student-Imposed Classifi-cation Questions	Responses to Student-Imposed Classifi-cation Questions	Total Classifi-cation Questions	Responses to Total Classifi-cation Questions
1.000	.997	.307	.301	.014	.059	.228	.231
	1.000	.305	.299	.015	.060	.228	.232
		1.000	.990	.165	.213	.778	.795
			1.000	.135	.183	.751	.779
				1.000	.989	.743	.718
					1.000	.775	.754
						1.000	.993
							1.000

Student Attitude Measure

The 11-item attitude measure was factor analyzed to determine if subsets of covarying variables could be explicated. An orthogonal factor analysis using a Varimax solution was employed to determine the principal axes factor matrix. The principal axes factor matrix accounted for 45.45 percent of the total score variance. An oblique factor analysis using a simple loadings solution was next performed. Oblique solutions are recommended when there is doubt that factors are completely orthogonal (Guertin and Bailey, 1970). Intercorrelations of the simple loadings for the primary oblique factors indicated that an oblique solution should be used to interpret the data. Four factors were extracted and rotated. Factors were examined and labeled according to the way factor loadings related to attitude items. Factors and their labels are found in Table 31.

In order to determine if there was a difference of response to the items comprising the four factors by students exposed to teachers in different treatments, one-way analyses of variance were performed between factors and treatment groups. Scores on each item for each of the four factors were summed. Total maximum scores (all "yes" responses) ranged from 6 in factors II and III to 9 for factors I and IV. Total minimum scores correspondingly were 2 and 3.

Table 31

Factors on the Student Attitude Measure

Item	I Lesson Enjoyment	II Naming Things	III Frustration	IV Learning in Small Groups
I liked this lesson.	.60			
Questions help me learn.	.61			
It was fun to put things into groups.	.53			.34
I like to tell the name of things.		.80		
I like to tell how things look.		.54		
The teacher asked too many questions.			.45	
This test is hard.			.65	
The teacher was nice.				.33
I learn better in small groups.				.51

A significant difference between treatments was found for factor III, labeled the frustration factor ($F=4.09$, $p<.05$). Scheffé's S test for multiple comparisons was used since cell size differences were large. Subjects who had been taught by the video model preservice teachers scored significantly higher than the control group. No significant differences were found between the audio and video model treatment or between the audio and the control groups. No significant difference between treatment groups was found for any of the three remaining factors. A high score on items 2 and 5 (factor III) indicated that students perceive the test and microteaching task as being difficult. No significant differences were found between groups on items comprising the three remaining factors. Tables 32 and 33 report the analysis of variance and Scheffé's S test for factor III. The remaining analyses of variance, the factor loadings, and the intercorrelation matrix are found in Appendix E.

Table 32

Analysis of Variance for Frustration Factor

Source of Variation	SS	df	MS	F
Between groups	12.08	2	6.04	4.09*
Within groups	207.92	141	1.47	
Total	220.00	143		

N = 144.
*p < .05.

Table 33

Scheffé's S Test for Difference Between Means--
Frustration Factor

Treatment	Cell Mean		Cell N
1) Video	3.19		48
2) Audio	2.82		51
3) Control	2.47		45
Contrasted pairs	1-2	1-3	2-3
Difference between means	.27	.72*	.35
Scheffe's S: *(p<.05);	.61	.61	.61
**(p<.01).	.75	.75	.75

Chapter IV

DISCUSSION AND IMPLICATIONS

This study examined the effects of two modes of modeling on the acquisition and performance of a teaching skill by preservice teachers and the effect that performance of the teaching skill had on elementary students. Video and audio models were compared to a no-model control group. The model teacher displayed observation and classification questioning behaviors, and elementary students responded by verbally answering the questions and by manipulation of objects. The model neither defined observation and classification questions nor did she verbally highlight an observation or classification question. That is, the model did not state, "This is an observation question" or "This is a classification question." All Ss in all treatments were introduced to the lesson materials before observing the model. This precaution was taken so that Ss in all treatments would have similar backgrounds before training. Validation of the effectiveness of the acquired teaching strategy (observation and classification questioning behavior) was also tested by examining the relationship of the performance of the teaching skill and student learning.

Treatment Main Effects

The first hypothesis tested was:

> Teachers observing the video model will produce higher frequencies of observation questions and higher frequencies in more categories of classification questions than teachers not exposed to the model as measured by audiotape and written performances.

Results on the teacher criterion test indicate that the video model treatment and the control did not perform in a significantly different way. This test required that subjects identify which test items were observations, classifications, or neither. A between-group comparison (Table 11) indicates that the video model Ss had a higher mean score on the teacher criterion test.

Of the four dependent variables used in analyzing the teacher audiotape performances, three had significant F ratios (Tables 16 through 19). Observation of the video model was more effective in training preservice teachers to ask observation questions than the control no-model condition (Table 20). Preservice teachers in the control group asked significantly fewer teacher-imposed classification questions than Ss in the video model condition (Table 21). No significant difference was observed between the control and video model treatments on the frequency of student-imposed classification questions (Table 18). Subjects who

observed the video model asked a significantly higher frequency of total classification questions than the control (Table 22). From the foregoing discussion, the data support the overall hypothesis that the video model produces greater performance of the desired teaching skill than the no-model condition. It should be noted that three of five dependent variables had F ratios which were significant in favor of the video model, and thus the hypothesis is generally accepted. This result is in agreement with the existing research on video models in teacher training (Koran, 1969b, 1970, 1971a; M. L. Koran et al. 1971).

The second hypothesis tested was:

> Teachers listening to the audio model will produce higher frequencies of observation questions and higher frequencies in more categories of classification questions than teachers not exposed to the model as measured by audiotape and written performances.

Subjects exposed to the audio model were able to identify which items were observations, classifications, or neither on the teacher criterion test significantly better than the control group (Table 11). Significant between-group differences were found on the frequency of observation questions asked, the frequency of teacher-imposed classifications, and the total number of classification questions (Tables 20 through 22). No difference was found

on the frequencies of student-imposed classification questions asked (Table 18). Although all of the dependent variables do not support this hypothesis, evidence was found in four out of five measures to support the hypothesis. The hypothesis that the audio model is superior to the no-model condition in producing more of the desired behaviors is generally supported by the data. Preservice teachers who observe a teaching strategy by means of an audio model reproduce the teaching strategy more effectively than teachers not exposed to the model. Training is necessary if appropriate teaching strategies of this nature are to be implemented.

The third hypothesis tested was:

> The video model will be more effective than the audio model in producing higher frequencies of observation questions and higher frequencies in more categories of classification questions as measured by audiotape and written performances.

No significant difference was found on the teacher criterion test between the audio and video model treatments (Table 11). Subjects in the audio model treatment did perform better as evidenced by their higher mean score. Although three audiotape dependent variables were found significant, no significant differences were found between the audio and video model treatments (Tables 20 through 22).

Preservice teachers who observed the video model performed as well as the audio model treatment _S_s. Video model _S_s asked more observation questions while audio model _S_s asked a higher frequency of student-imposed classification questions. The data and results discussed do not support the third hypothesis.

The fourth hypothesis tested was:

> Teachers eliciting higher frequencies of observation questions and higher frequencies in more categories of classification questions will produce higher student scores on the written and audiotape performances.

No significant differences were found between the four student treatment conditions on the student process test. The student process test was a 20-item test requiring the students to make observations and classifications of geometric shapes and terms. The test was not difficult as indicated by the mean test difficulty of 0.24. Many students received perfect scores. Examination of the data indicates that the test may have been more a measure of reading ability than a measure of observation and classification skills. Students appear to have been able to perform the required written processes even without experiencing the microteaching lesson. This is evident from the equivalent scores of the posttest only cell (Table 12).

Of the four audiotape student dependent variables, three were found significant (Tables 23 through 26). Comparisons between treatments indicate that the audio and video model treatments produced significantly more student responses than the control (Tables 27 through 29). It follows that teachers who ask more observation and classification questions will produce more student responses in these categories. Control subjects asked few observation and classification questions and thus elicited fewer student responses. The fourth hypothesis is generally supported by the data, but again it should be noted that the decision to accept this hypothesis is based upon three out of five dependent variables with significant F ratios. Between-group comparisons revealed that there was no significant difference on the student process test, perhaps because of the test's simplicity. Students exposed to preservice teachers who elicited more of the appropriate behaviors responded more frequently.

Interpretation

A number of theories have been introduced to explain the effects of modeling. Bandura (1970) and Sheffield (1961) interpreted the modeling process as a contiguity-mediational process whereby stimuli become integrated into perceptual responses. Extrapolating from this, one might expect the following types of results from the observation

of an audio or a video model. When the tasks performed by the model are primarily psychomotor with little verbalization of the processes, the video model should be superior to the audio model. Bandura's work on agression in children where the model displays physical agressive behavior is an example of this case. If the tasks are verbal and the psychomotor components are negligible, both audio and video models should be equally effective. In the psychomotor case auditory input would not facilitate acquisition of the behaviors by means of an audio model. In the second case both models should be equivalent in effect. If the video model is particularly distinctive, the potency of the model may be in favor of the video model (Bandura, 1973).

The model teacher and students in this study displayed some psychomotor actions. Yet, most of the interactions between the model teacher and students were verbal. The audio model Ss were able to observe the verbal interactions along with some verbal indication of the manipulations that were taking place. In the modeling treatments tasks the Ss were trained to perform were verbal. That is, the asking of questions of the type used required the synthesis and reorganization of the stimuli. When the above training occurs and teacher performance is enhanced, it can be expected that student performance will also increase.

The manipulations of objects demonstrated in the video model may not have afforded the video model Ss added cues

as to the nature of the task. Allen et al. (1967) suggested that, for verbal skills such as the ones used in this study, the video model may be superfluous and a written transcript model of the video model may be just as appropriate. The audio model used in this study was an audio transcript of the video model.

Another explanation for the lack of support for the third hypothesis is that, although the video model supplies both verbal and visual stimuli, other factors may have interfered with the video model's potency. Attentional involvement may be greater in observing the audio model than the video model. Since fewer stimuli are offered by the audio model the subject may be required to focus on the audio interaction more closely. M. L. Koran et al. (1971) stated that video models are rich in perceptual detail, with a complex mixture of relevant and irrelevant cues. Subjects observing the video model may have had an overabundance of information. That is, Ss may have concentrated on the manipulations of objects, on facial expressions, or on the verbal stimuli. Allen et al. (1967) agreed that video models may be unnecessarily rich in behaviors and that observers may have too many cues to which to attend. Subjects observing the audio model had to focus on one stimulus mode and, when manipulations (putting things into groups) were noted, the S mentally made a similar manipulation. These mediational processes required by the audio

model may serve as a practice variable and thus reinforce retention of the behavior. Practice variables serve as rehearsal operations which strengthen acquired responses.

The discussion of modeling behavior in children (Chapter I) suggested that children model those individuals who appear to possess a high degree of competence more than individuals perceived as ineffective (Bandura, et al., 1963). Preservice teachers who elicited high frequencies of observation and classification questions can be thought of as being competent models for these behaviors. Students exposed to these teachers will tend to model the desired behaviors more.

It has been suggested by Koran and Wilson (1974) that learning can be represented as a five-phase paradigm.

Acquisition---> Performance---> Practice--->

Retention---> Transfer

is used here to suggest that students exposed to preservice teachers in both video and audio model treatments learned more of the desired processes (observing and classifying) than students in the control group. The data suggest that both modeling conditions required students to perform the desired behaviors and practice the behaviors more than the control. Although no pretreatment measure was employed to determine if all students could observe and classify approximately as well, the practice of scientific processes may lead to retention. When confronted with another set

of stimuli, students who practiced and retained observation and classification processes could make generalizations towards the new stimuli.

Student Attitudes

Four factors were extracted by a factor analytic procedure. Analysis of variance on clusters of items that comprised each factor indicated that there was a significant difference between treatments on the frustration factor (factor III, see Table 31). Students exposed to the video model indicated that "the test was hard" and that "the teacher asked too many questions" more often than students in the control group (Table 32). Between-group comparisons for the video and audio treatments and the audio and control showed no significant differences. High scores on items comprising factor III indicate that students in the video model treatment considered the tasks and test to be difficult. Video model teachers did ask many more questions than control teachers. Students may have considered the large number of questions and manipulations excessive.

The other three factors were: lesson enjoyment, naming things, and learning in small groups (Table 30). No significant differences were found between groups on responses to clusters of items comprising these factors. Factor loadings indicate that all treatment conditions produced approximately the same affective set for these three factors.

Audio Modeling: Some Practical Considerations

It was previously suggested that, if audio models prove effective as teacher training devices, their application can be widespread. Audio models of the type used in this study are inexpensive to produce as measured by the relative costs of equipment and materials. Audio models and the cassette recorders necessary for their display are more portable than video monitors and videorecorders. Audio models can be developed by school districts, state departments of education, and colleges of education as modes of training teachers in the evolving list of teacher competencies. This study alone does not afford sufficient evidence to suggest that audio models are as effective as video models although, for the tasks modeled and Ss used, both modes were equally effective. So when cost and logistics prove to be training constraints and the task is a verbal one, audio models appear to provide a promising training method.

Modeling: Some Implications for Research

In Teacher Training. Many different types of audio and video models need to be investigated. Teacher questioning behavior has been explored in this and other studies. It may be possible to develop and test models that are efficient in altering the existing behavior of teachers as newer, more effective teaching strategies are developed.

Many of the modern science curricula require that teachers employ problem-solving techniques and stress divergent thinking. Models can be developed that exhibit a teacher using problem-solving strategies in a microteaching setting. Other models may stress hypothesizing, making inferences, and using experimental procedures.

Verbal highlighting may strengthen the potency of the model. The model exhibits a behavior and verbally notes, "I am stressing hypothesis making" or "This statement is a hypothesis." The observer of the model receives various sets of stimuli--the model, student responses, and the effect of highlighting. Allen et al., (1967) have used audiotapes as a feedback mechanism that highlighted essential behaviors displayed by a video model. The incorporation of the model and feedback into one package may prove a very effective model. Similar models could be developed and compared where one model exhibits a teacher eliciting hypothesis-making while the second model exhibits hypothesis-making plus verbal highlighting.

Repeated exposures to the same model or different models should be investigated. A model displays a particular strategy. Part of the experimental sample observes the model once, another sample observes the model twice, and so on. Acquisition and performance of the behavior should be examined in a microteaching session. This allows student performance to be measured along with teacher

performance. Complex teaching strategies may be appropriate for repetitive exposures to the same or a different model. Simple strategies such as observation and classification questioning are probably acquired in one exposure to the model, so that repeated exposures would show a ceiling effect when measured.

Classroom Applications. Many of the same tasks that should be investigated with teachers are appropriate to students as well. Students can be selected as models to be used in teaching other students problem-solving, experimenting, making inferences, etc. Koran and Deture (1974) have completed a pilot study examining the effects of student models on the acquisition of scientific processes by other students. Much more research is needed in this area. Cultural and physical characteristics of the model may be of great importance to the potency of the model. Teacher models should be compared to student models, black models to white models, male models to female models. Finally, research should continue into the relative strengths of models and operant conditioning in classroom application and the relationship between acquired teacher performance and related student learning as a basis for competency-based teacher training.

Conclusions

Support was found in this study for the efficacy of audio models as teacher-training devices. Further support was also found indicating that video models are effective in training teachers. Teachers not trained to ask observation and classification questions performed significantly fewer of these behaviors than teachers trained via the models. Students taught by teachers in the modeling treatments responded more frequently than students taught by nontrained teachers.

Practical applications of audio and video models are numerous as teacher-training methods and as student instructional alternatives. Much research remains to be undertaken to examine a number of variables and their effects on the modeling process.

APPENDICES

APPENDIX A

SET INDUCTION MATERIALS

SET INDUCTION
VIDEO, AUDIO MODEL TREATMENTS*

______ Name____________________

The Development of Concept Formation Skills

Please read the following instructions very carefully.

It is believed that one of the major objectives of a teacher is to help students form concepts. Much of the learning that occurs in schools and in the world is simplified through the acquisition of concepts. Therefore, it is the role of the teacher to assist students in developing concept-formation skills and in acquiring new concepts. Concept formation can be broken down into four procedures: observation, classification, generalization, and discrimination.

It will be your task to prepare and teach a lesson eliciting observation and classification questions from three students.

Observe the materials that will be available to you in teaching the lesson. Do not manipulate the materials now.

---

*This title was not present on the original set induction.

After reading the previous information on this handout and observing the materials, please observe the following demonstration and then prepare a 15-minute lesson. You may use the observed materials as part of the lesson.

The lesson will be audiorecorded.

You will have 5 minutes to prepare the lesson.

SET INDUCTION
CONTROL GROUP*

Name____________________

The Development of Concept Formation Skills

Please read the following instructions very carefully.

It is believed that one of the major objectives of a teacher is to help students form concepts. Much of the learning that occurs in schools and in the world is simplified through the acquisition of concepts. Therefore, it is the role of the teacher to assist students in developing concept-formation skills and in acquiring new concepts. Concept formation can be broken down into four procedures: observation, classification, generalization, and discrimination.

It will be your task to prepare and teach a lesson eliciting observation and classification questions from three students.

Observe the materials that will be available to you in teaching the lesson. Do not manipulate the materials now.

*This title was not present on the original set induction.

After reading the previous information on this handout and observing the materials, prepare a 15-minute lesson. You may use the observed materials as part of the lesson.

The lesson will be audiorecorded.

You will have 5 minutes to prepare the lesson.

APPENDIX B

MATERIALS LIST

SCIENCE--A PROCESS APPROACH
OBSERVATION AND CLASSIFICATION KIT

Colored Wood Blocks (6)
Colored Balloons
Assorted Pieces of Felt Cloth
Colored Rectangles--Construction Paper
Hard-Shell Nuts
Paper Plates

AUDIOVISUAL MATERIALS
AND EQUIPMENT

2 Wollensak Cassette Recorders
Sony 2200V Videocorder
19-inch Monitor
Videotape Model
Audiotape Model
48 Audiotape Cassettes

APPENDIX C

WRITTEN MEASURES

TEACHER CRITERION TEST

Name ____________________

Directions: Place O (for observation), C (for classification), or N (for neither) beside each question or statement.

1. Which plate does this belong on?
2. How can we separate these?
3. What is similar about all these things?
4. How are cucumbers and bananas similar?
5. Which one of these is different from the rest?
6. Can you tell me which of these does not have three sides?
7. How does this feel?
8. Which are the smooth objects?
9. What is the difference between A and B?
10. How are circles and triangles different?
11. What does a signature on a picture indicate?
12. How are these boxes different?
13. How does the sun feel?
14. What is similar about tacks and nails?
15. What is the difference between draperies and curtains?
16. What color is the sky?
17. Oranges and apples are fruits.
18. Polygons are many-sided figures.
19. Capitalism is an economic system.
20. How tall are you?
21. Lemons taste sour.
22. Freckles and moles are skin characteristics.
23. What is the wind-chill factor today?
24. How are these things different?
25. How are radios and televisions alike?
26. In what ways can you group these?
27. What shape does this look most like?
28. Why did you group these this way?

STUDENT TEST

Name____________________

Put the letters for the answers you think are best in the space beside the number.

________ 1. Choose the ones that look alike.

a b c d

________ 2. Which are the large ones?

c d

a b

________ 3. Which picture looks like  ?

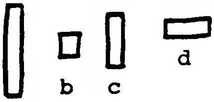
a b c d

________ 4. Put into 2 groups.

____

a b c d

________ 5. Which is the tallest?



d

a b c

________ 6. Which are alike?

a b c d

________ 7. Which one is different?

a b c d

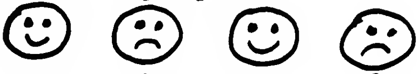
________ 8. Which one does not belong?

Horse Tree Dog Fish

a b c d

________ 9. Put into 2 groups.

____



a b c d

________10. Which looks like  ?

a b c d

________11. Which is the smallest?

a b c d

________12. Which is round?

a b c d

________13. Which picture does  look like?

a b c d

________14. Which 2 are alike?

Pony Cat Bird Horse

a b c d

________15. Which picture looks like  ?

a b c d

________16. Which 2 are the smallest?

________17. Put the 2 that you think belong together.

a b c d

________18. Which one has more lines?

a b c d

________19. Which looks more like  ?

a b c d

________20. Which 2 are biggest?

a b c d

STUDENT ATTITUDE MEASURE

Name ________________________

Circle the answer you like best.

Yes	No	Don't Know	I like this lesson.
Yes	No	Don't Know	The teacher asked too many questions.
Yes	No	Don't Know	Questions help me learn.
Yes	No	Don't Know	The teacher was nice.
Yes	No	Don't Know	This test is hard.
Yes	No	Don't Know	It was fun to put things into groups.
Yes	No	Don't Know	I like questions.
Yes	No	Don't Know	I like to tell the name of things.
Yes	No	Don't Know	I learn better in a small group.
Yes	No	Don't Know	I talk more in small groups.
Yes	No	Don't Know	I like to tell how things look.

APPENDIX D

RATER TRAINING MANUAL

RATER TRAINING MANUAL

Your task is to analyze a series of audiotapes for type and frequency of observation and classification questions by teachers and responses by students. Please read the following material carefully.

Definitions of Observation and Classification Questions:

Observation Questions: Questions which require from the students observations about one or more physical characteristic are observation questions. Observations can relate to color, size, texture, or shape.

Examples of Observation Questions:

What color is this?

What shape is your balloon?

How does the nut feel?

Classification Questions: Questions which require students to classify objects by one or more characteristics. There are two types or categories of classification questions.

Teacher-Imposed Classification Question: When asking this question the teacher imposes the characteristic or characteristics to be used in placing the objects into categories.

Examples: How can you arrange these by size?

Separate these objects using color.

Put these into groups using texture as a guide.

Student-Imposed Classification Question: When asking this question the teacher allows the student to develop the characteristic the student believes is appropriate in placing the objects into categories.

Examples: Where could you put these?

How can we separate these?

Are these the same or different?

Can you make groups of these objects?

How are these nuts different?

What thing about these groups is alike?

Student Responses: Rate one or more correct student responses to a particular question as one response. The teacher must verbalize each question in order for a correct student response to be coded.

Teacher ______________________ Tape ________ Rater ________________

[OBSERVATIONS]

Shape	Teacher		
	Student		
Texture	Teacher		
	Student		
Size	Teacher		
	Student		
Color	Teacher		
	Student		
Other	Teacher		
	Student		

Teacher Observations Total _____ Student Responses _____

[CLASSIFICATIONS]

Teacher-Imposed Categories		
Student-Imposed Categories		

Teacher Total Categories _____ Student Total Categories ___

_____ ___

APPENDIX E

FACTOR ANALYSIS DATA

Means and Standard Deviations by Items--
Student Attitude Measure

Item	Mean	SD
1	2.82	0.54
2	1.52	0.82
3	2.80	0.59
4	2.90	0.44
5	1.31	0.69
6	2.76	0.62
7	2.48	0.84
8	2.65	0.69
9	2.42	0.86
10	2.00	0.93
11	2.76	0.58

Oblique Primary Factor Matrix--Simple Loadings Solution

Items	I	II	III	IV
1	0.60	0.24	-0.01	-0.02
2	-0.12	0.45	0.06	-0.22
3	0.61	0.10	0.01	0.01
4	0.04	-0.28	0.33	0.41
5	-0.04	0.65	-0.13	0.04
6	0.53	-0.03	0.34	0.02
7	0.39	0.01	-0.21	0.25
8	-0.06	0.04	0.02	0.80
9	0.01	-0.01	0.51	-0.01
10	0.08	0.32	0.24	0.12
11	0.26	0.03	-0.09	0.54

Intercorrelations of Primary Factors

Factor	1	2	3	4
1	1.00	-0.18	0.18	0.57
2		1.00	0.01	-0.09
3			1.00	1.17
4				1.00

Analysis of Variance for Learning in Small Groups

Source of Variation	SS	df	MS	F
Between groups	2.07	2	1.03	0.53
Within groups	272.93	141	1.94	
Total	275.00	143		

N = 144.

Analysis of Variance for Lesson Enjoyment

Source of Variation	SS	df	MS	F
Between groups	1.20	2	0.60	0.34
Within groups	250.55	141	1.78	
Total	251.75	143		

N = 144.

Analysis of Variance for Naming Things

Source of Variation	SS	df	MS	F
Between groups	0.67	2	0.33	0.27
Within groups	176.16	141	1.25	
Total	176.83	143		

N = 144.

REFERENCES

Allen, D. W., Berliner, D. C., McDonald, F. C., and Sobol, F. T. 1967. A comparison of different modeling procedures in the acquisition of a teaching skill. Paper presented at the meeting of the American Education Research Association, New York.

Bandura, A. 1965a. Vicarious processes: A case of no trial learning. In L. Berkowitz (ed.), Advances in experimental social psychology. Vol. II. Academic Press. New York.

Bandura, A. 1965b. Influence of models' reinforcement contingencies on the acquisition of imitative responses. Journal of Personality and Social Psychology, 1, 589-595.

Bandura, A. 1967. Externalization of the superego: Comments on conduct and conscience. In M. Hoffman (ed.), Character development in the child. Aldine. Chicago.

Bandura, A. 1969. Principles of behavior modification. Holt, Rinehart & Winston. New York.

Bandura, A. 1970. Modeling theory: Some traditions, trends and disputes. In W. Sahakian (ed.), Psychology of learning. Markham. Chicago.

Bandura, A. 1971. Psychological modeling. Aldine-Atherton. Chicago.

Bandura, A. 1973. Aggression: A social learning analysis. Prentice-Hall. Englewood Cliffs, New Jersey.

Bandura, A. and Huston, A. 1961. Identification as a process of incidental learning. Journal of Abnormal and Social Psychology, 63, 311-318.

Bandura, A. and Walters, R. 1959. Adolescent aggression. Ronald. New York.

Bandura, A. and Walters, R. 1963. Social learning and personality development. Holt, Rinehart & Winston. New York.

Bandura, A., Grusec, J., and Menlove, F. 1966. Observational learning as a function of symbolization and incentive set. Child Development, 37, 499-506.

Bandura, A., Ross, Dorothea, and Ross, W. 1963. Vicarious reinforcement and imitative learning. Journal of Abnormal and Social Psychology, 67, 601-607.

Bronfenbrenner, U. 1970. Two worlds of childhood. Russell Sage Foundation. New York.

Brunstein, E., Stotland, E., and Zander, A. 1961. Similarity to a model and self-evaluation. Journal of Abnormal and Social Psychology, 52, 257-264.

Denney, D. 1972. Modeling effects upon conceptual strategies. Child Development, 43, 810-823.

Dodl, N. R. 1973. The Florida catalog of teacher competencies. Florida Department of Education, Chipley, Florida.

Elam, S. 1971. Performance-based teacher education: What is the state of the art? American Association of Colleges for Teacher Education. Washington, D.C.

Gagné, R. 1963. The individual basis of scientific inquiry. Paper presented at summer writing conference, Science-A Process Approach, Stanford, University, California.

Gagné, R. 1970. The conditions of learning. Holt, Rinehart and Winston. New York.

Geshuri, Y. 1972. Observational learning: Effects of observed reward and response patterns. Journal of Educational Psychology, 63 (4), 374-380.

Guertin, W. and Bailey, J. 1970. Introduction to modern factor analysis. Edwards Brothers, Inc. Ann Arbor, Michigan.

Hartup, W. 1969. Peer interaction and social organization. In P. Mussen (ed.), Manual of child psychology. John Wiley & Sons. New York.

Houston, W. R. 1972. Designing instructional systems for performance-based programs. American Association of Colleges for Teacher Education. Houston, Texas.

Hurd, P. and Gallagher, J. 1968. New directions in elementary science teaching. Wadsworth. Belmont, California.

Karplus, R. and Thier, H. 1967. A new look at elementary school science. Rand McNally. Chicago.

Koran, J. J., Jr. 1969a. Two paradigms for training of science teachers using videotape and simulated conditions. Journal of Research in Science Teaching, 6, (3), 22-28.

Koran, J. J., Jr. 1969b. The relative effects of classroom instruction and subsequent observational learning on the acquisition of a questioning behavior by science teachers. Journal of Research in Science Teaching, 6 (3), 217-223.

Koran, J. J., Jr. 1970. A comparison of the effects of observational learning and self-rating on the acquisition and retention of a questioning behavior by elementary science teacher trainees. Science Education, 54 (4), 385-389.

Koran, J. J., Jr. 1971a. A study of the effects of written and film-mediated models on the acquisition of a science teaching skill by preservice elementary teachers. Journal of Research in Science Teaching, 8 (1), 45-50.

Koran, J. J., Jr. 1971b. Concepts and concept formation in teaching high school biology. American Biology Teacher, 33 (7), 405-408.

Koran, J. J., Jr. 1972. The use of modeling, feedback, and practice variables to influence science teacher behavior. Science Education, 56 (3), 285-291.

Koran, J. J. and Deture, L. 1974. The use of film-mediated models to prompt children's scientific process activities: A pilot study. Paper presented at the meeting of the National Association for Research in Science Teaching, Chicago.

Koran, J. J. and Wilson, J. 1974. Research on mathemagenic behavior: Implications for science instruction and learning. Paper presented at the National Association for Research in Science Teaching, Chicago.

Koran, J. J., Jr., Koran, M. L., and McDonald, F. J. 1972. Effects of different sources of positive and negative information on observational learning of a teaching skill. Journal of Educational Psychology, 63 (5), 405-410.

Koran, J. J., Jr., Koran, M. L., Loose, K. D., and Santiesteban, A. J. 1973. Validating a teacher behavior by student performance. Research report. Institute for Development of Human Resources, College of Education, University of Florida, Gainesville, Florida.

Koran, M. L., Snow, R., and McDonald, F. 1971. Teacher aptitude and observational learning of a teaching skill. Journal of Educational Psychology, 62 (3), 219-228.

Leifer, A., Collins A., Gross, B., Taylor, P., Andrews, L., and Blackmer, E. 1971. Developmental aspects of variables relevant to observational learning. Child Development, 42, 1509-1516.

Liebert, R., Odom, R., Hill, J., and Huff, R. 1969. Effects of age and rule familiarity on the production of modeled language constructions. Developmental Psychology, 1 (2), 108-112.

Masters, J. and Morris, R. 1971. Effects of contingent and noncontingent reinforcement upon generalized imitation. Child Development, 42, 385-397.

Mechner, F. 1965. Science education and behavioral technology. In Glaser, R. (ed.), Teaching machines and programmed learning II data and directions. National Education Association. Washington, D.C.

Mussen, P. and Parker, A. 1965. Mother-nurturance and girls' incidental imitative learning. Journal of Personality and Social Psychology, 2, 94-97.

Pella, M. 1966. Concept learning in science. Science Teacher, 33, 31-34.

Portuges, S. and Feshbach, N. 1972. The influence of sex and socioethnic factors upon imitation of teachers by elementary school children. Child Development, 43, 981-989.

Rosekrans, M. 1967. Imitation in children as a function of perceived similarities to a social model of vicarious reinforcement. Journal of Personality and Social Psychology, 7, 307-315.

Rosenshine, B. and Furst, N. 1971. Research in teacher performance criteria. In B. O. Smith (ed.), Research in teacher education: A symposium. Prentice-Hall. Englewood Cliffs, New Jersey.

Rowe, Mary Budd. 1973. Teaching science as continuous inquiry. McGraw Hill Book Co. New York.

Rowe, Mary Budd. 1974. Wait-time and rewards as instructional variables, their influence on language, logic, and fate control: Part one--wait-time. Journal of Research in Science Teaching, 11, 81-94.

Sheffield, F. D. 1961. Theoretical considerations in learning of complex sequential tasks from demonstration and practice. In A. A. Lumsdaine (ed.), Student responses in programmed instructions: A symposium. National Academy of Sciences, National Research Council. Washington, D.C.

Siegel, M. and B. Rosenshine. 1973. Teacher behavior and student achievement in the Bereiter-Engelman Follow-Through program. Paper presented at the meeting of the American Education Research Association, New Orleans, Louisiana.

Stotland, E. and Dunn, R. 1962. Identification, oppositeness, authoritarianism, self-esteem and birth order. Psychological Monographs, 76, 9.

Stotland, E., Zander, A., and Natsonlas, T. 1962. Generalization of interpersonal similarity. Journal of Abnormal and Social Psychology, 61, 250-256.

Zimmerman, B. and Pike, E. 1972. Effects of modeling and reinforcement on the acquisition and generalization of question-asking behavior. Child Development, 43, 892-907.

BIOGRAPHICAL SKETCH

A. Joseph Santiesteban was born in Holguin, Cuba, on February 5, 1943. He immigrated to the United States at the age of three, settling with his family in Miami, Florida. After attending public schools in Miami, he earned the degree Bachelor of Science with a major in zoology from the University of Miami in 1966. Finding work in industry unrewarding, he returned to school, earning the degree Master of Education at Florida Atlantic University. He taught in parochial school for one year and in public schools for five years. He enrolled in the Graduate School of the University of Florida, where he received the degree of Doctor of Philosophy with a major in curriculum and instruction in 1974. While attending the University of Florida, he taught science methods, supervised science interns and performed educational research.

In 1969, Joseph Santiesteban was married to the former Leila Camille Cheshire. They have two children, Joanna Lourdes and Michael Theodosius. The future is uncertain for all, but he hopes to teach science methods in a college or university and to undertake interesting and varied research projects.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

John J. Koran, Jr., Chairman
Associate Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary Budd Rowe
Associate Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Vynce A. Hines
Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eugene A. Todd
Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert E. Jester
Robert E. Jester
Associate Professor of Education

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1974

B. J. Sharp by M C Baller
Dean, College of Education

H. H. Sisler
Dean, Graduate School